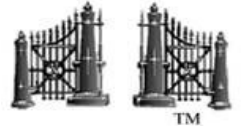


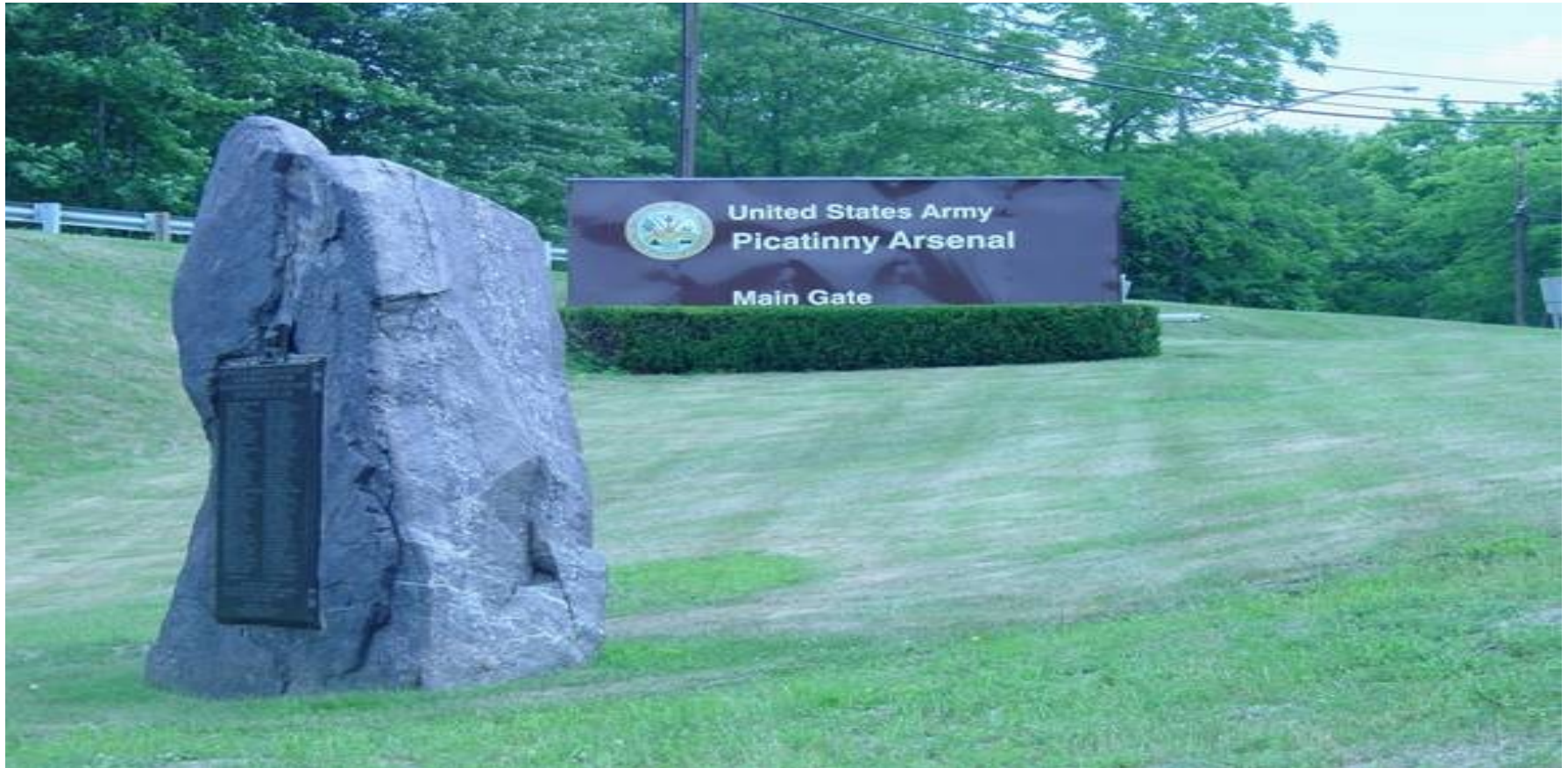


# Groundwater Remedy Updates RAB Presentation February 6, 2014

US Army Garrison



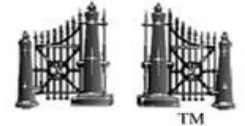
Picatinny Arsenal





# ARCADIS IRP Task Order (2006 – 2014)

US Army Garrison



Picatinny Arsenal

|                              | FS           | PP           | ROD          | RD           | RA           | RAR          | LTM/O        | Comments   |
|------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--|
| PICA 01 (25 Site Group)      | Complete     | Complete     | Feb-14       |              |              |              |              | NFA with Monitoring of Land Use                  |
| PICA 11 (45 Site Group)      | Complete     | Feb-14       |              |              |              |              |              | NFA with Monitoring of Land Use                  |
| PICA 11 (5 Site Group)       | Feb-14       |              |              |              |              |              |              | Soil Removal Action at 3 Sites                   |
| PICA 08 (Group 3 Sites)      | Complete     | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | Concentrations nearly at Clean Up Goals          |
| PICA 13 (Building 91 GW)     | Complete     | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | Concentrations below clean up goals              |
| PICA 20 (Group of 13 Sites)  | Complete     | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | LUCs   |
| PICA 57 (Lakes Group)        | Feb-14       |              |              | Not Required |              |              |              | Goal to achieve NFA/LUC ROD before December 2014 |
| PICA 57 (Non Lakes Group)    | Feb-14       |              |              | Not Required |              |              |              | Goal to achieve NFA/LUC ROD before December 2014 |
| PICA 65 (Post Farm Landfill) | Complete     | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | Concentrations below clean up goals              |
| PICA 66 (Site 20/24)         | Not Required |              |              |              |              |              | On Going     | LUCs   |
| PICA 67 (Sanitary Landfill)  | Not Required | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | LUCs   |
| PICA 72 (Former DRMO)        | Not Required | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | LUCs   |
| PICA 76 (Area D GW)          | Not Required |              |              | Complete     | Complete     | Complete     | On Going     | MNA occurring faster than originally predicted   |
| PICA 77 (Area E GW)          | Not Required | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | MNA occurring faster than originally predicted   |
| PICA 79 (Group 1 Sites)      | Not Required | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | LTM of groundwater and sediment ongoing          |
| PICA 93 (Waste Piles)        | Not Required | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | LUCs   |
| PICA 102 (Waste Dumps)       | Not Required | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | LUCs   |
| PICA 193 (Green Pond Brook)  | Not Required |              |              |              | Complete     | Complete     | On Going     | LTM of sediment and surface water                |
| PICA 204 (Mid Valley GW)     | Complete     | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | 1 year (of 23 complete)                          |
| PICA 205 (Area B GW)         | N/A          | Complete     | Complete     | Complete     | Complete     | Complete     | On Going     | Concentrations nearly at Clean Up Goals          |
| Document Summary             | FS           | PP           | ROD          | RD           | RA           | RAR          | LTM/O        | Comments   |
| Approvals                    | 7 out of 10  | 13 out of 17 | 12 out of 17 | 13 out of 16 | 14 out of 17 | 14 out of 17 | 15 out of 18 | 6 of 9 LTM/O programs 'ahead of schedule'        |



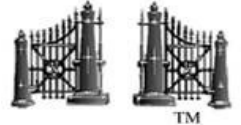


# RAB UPDATE

## Mid Valley Groundwater

February 6, 2014

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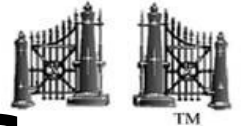


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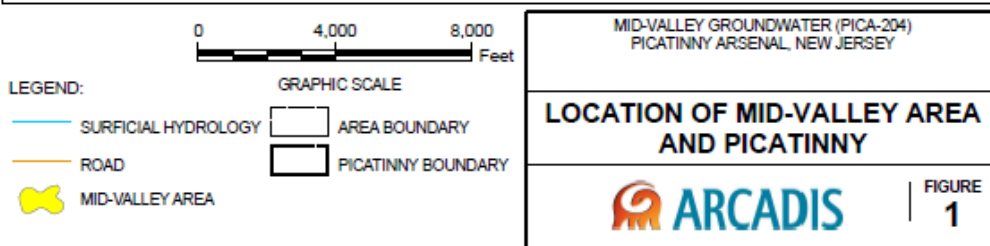
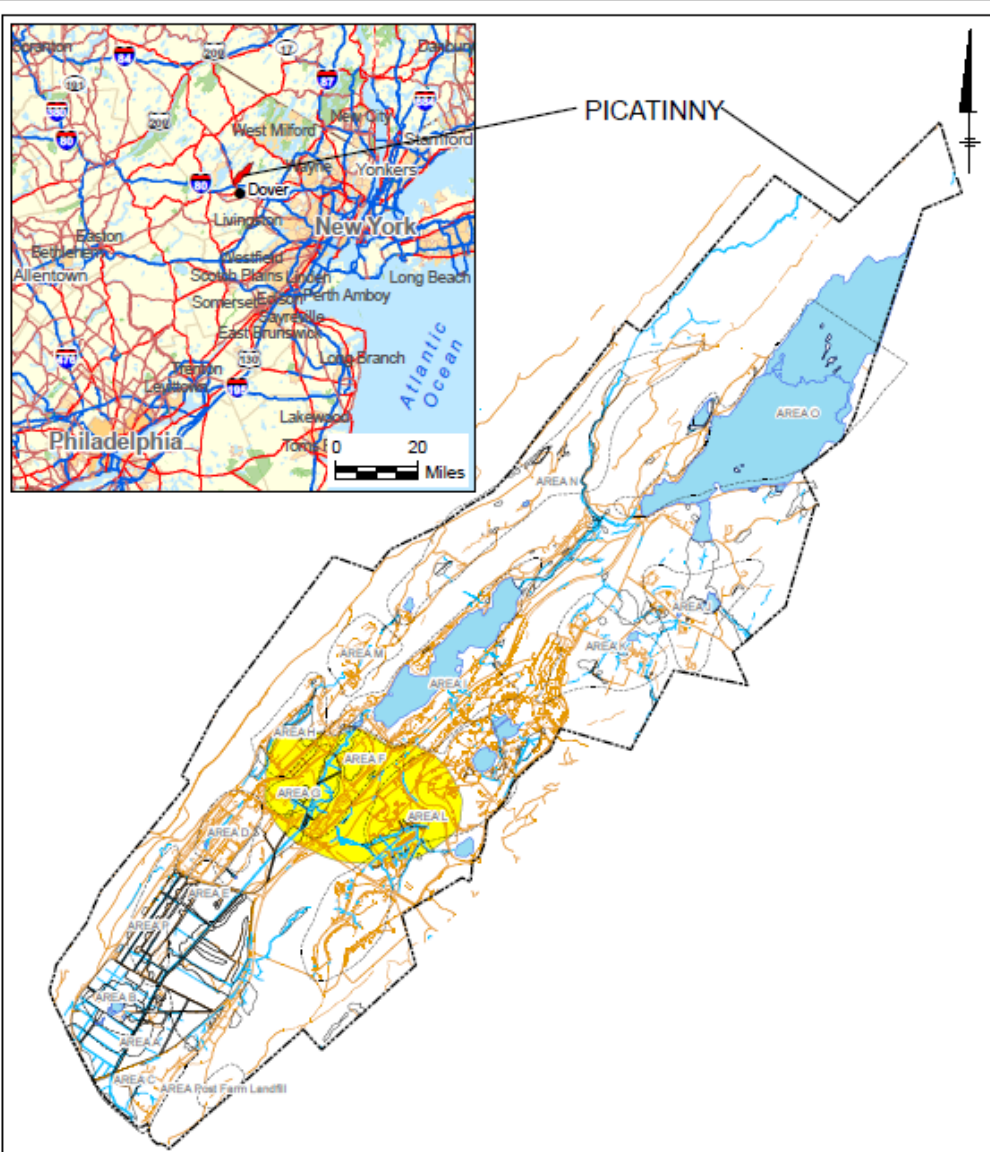


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# Status of CERCLA Process

- ✓ Remedial Investigation (Characterization of Site)
- ✓ Feasibility Study (Assessment of possible remedies)
- ✓ Proposed Plan (Public document to solicit input on preferred remedy)
- ✓ Record of Decision (Final legal document selecting remedy)
- ✓ Remedial Action (Implement Remedy)
- ☐ Long Term Operation, Monitoring and Maintenance



# Selected Remedy

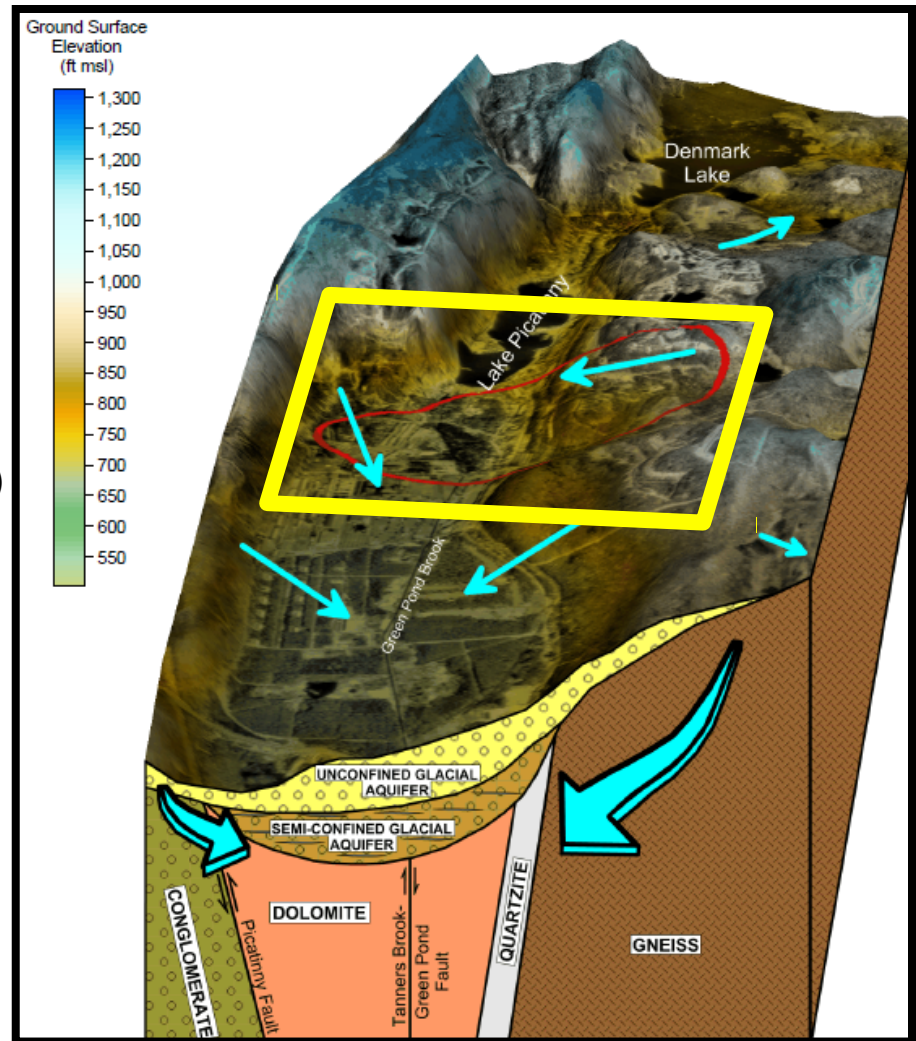
- In-situ bioremediation with MNA for TCE contaminated groundwater
  - Inject emulsified vegetable oil (EVO) into 18 wells at head of plume where concentrations are highest. Achieve remedial goals in 35 years (instead of 190 years)
- MNA for RDX contaminated groundwater
  - Achieve remedial goals in 15 years for the shallow plume and 35 years for the



## Regional Conceptual Site Model

- Geology

- Glacial valley fill with bedrock uplands
- Surface water bodies present include Robinson Run and Green Pond Brook
- Groundwater flow directions are towards the valley (Green Pond Brook) and locally towards Robinson Run





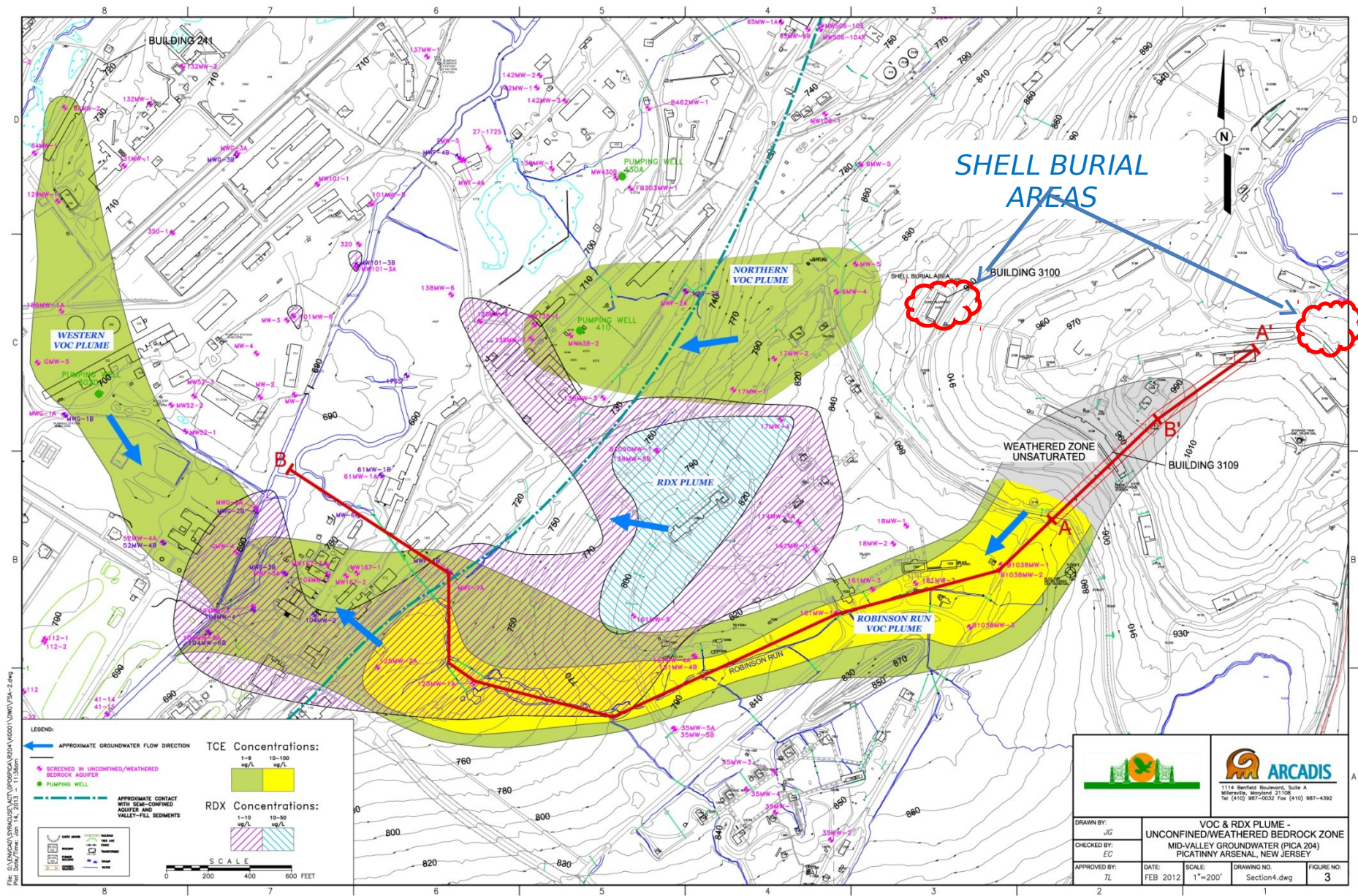


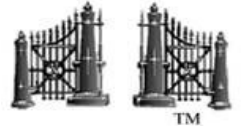
Fig. 43: UNCONFINED/WEATHERED BEDROCK ZONE (PICA 204) - VOC & RDX - 2.dwg  
Plot Date/Time: Jan 14, 2013 11:30am





# 2013 In-Situ Bioremediation Activities

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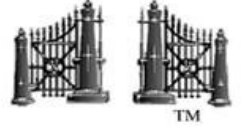
- February – March: Baseline performance monitoring
- March: First EVO injection
- December: Second EVO injection
- 3 quarterly monitoring events since injection
  - May
  - August
  - December
- Already seeing favorable results in several wells







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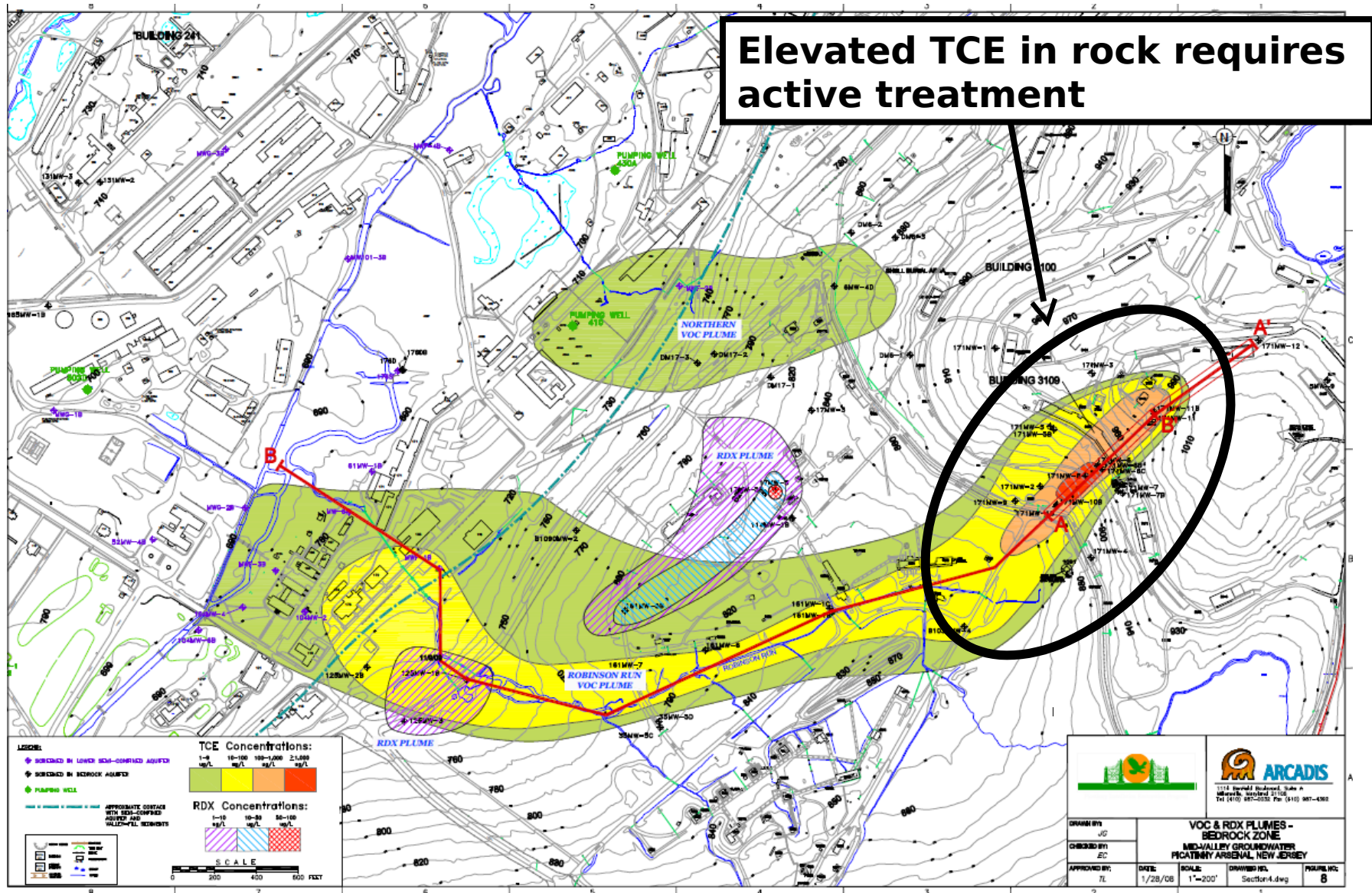


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# Mid Valley Groundwater

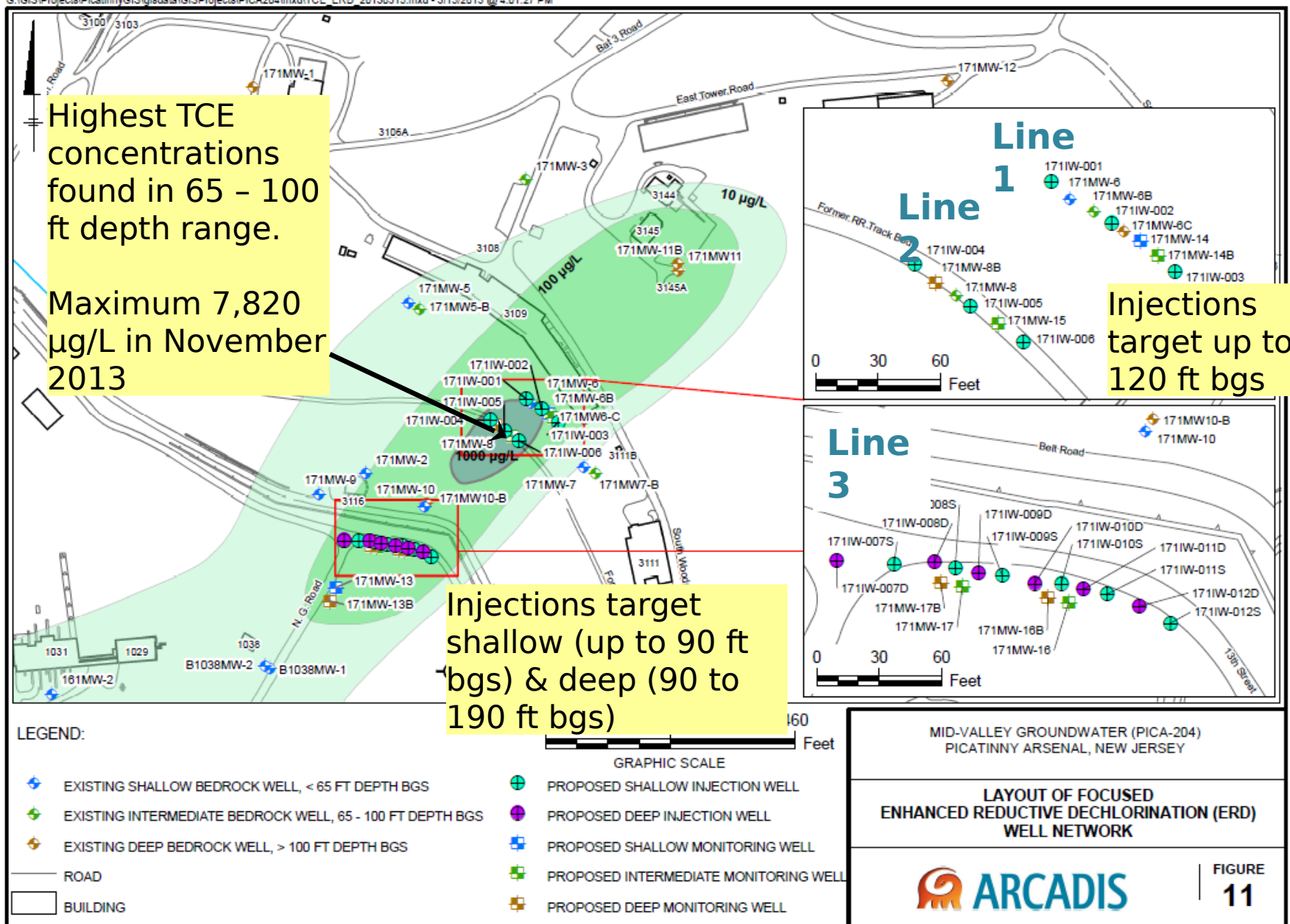
Enhanced Reductive  
Dechlorination VOC Plume

# Deeper Groundwater

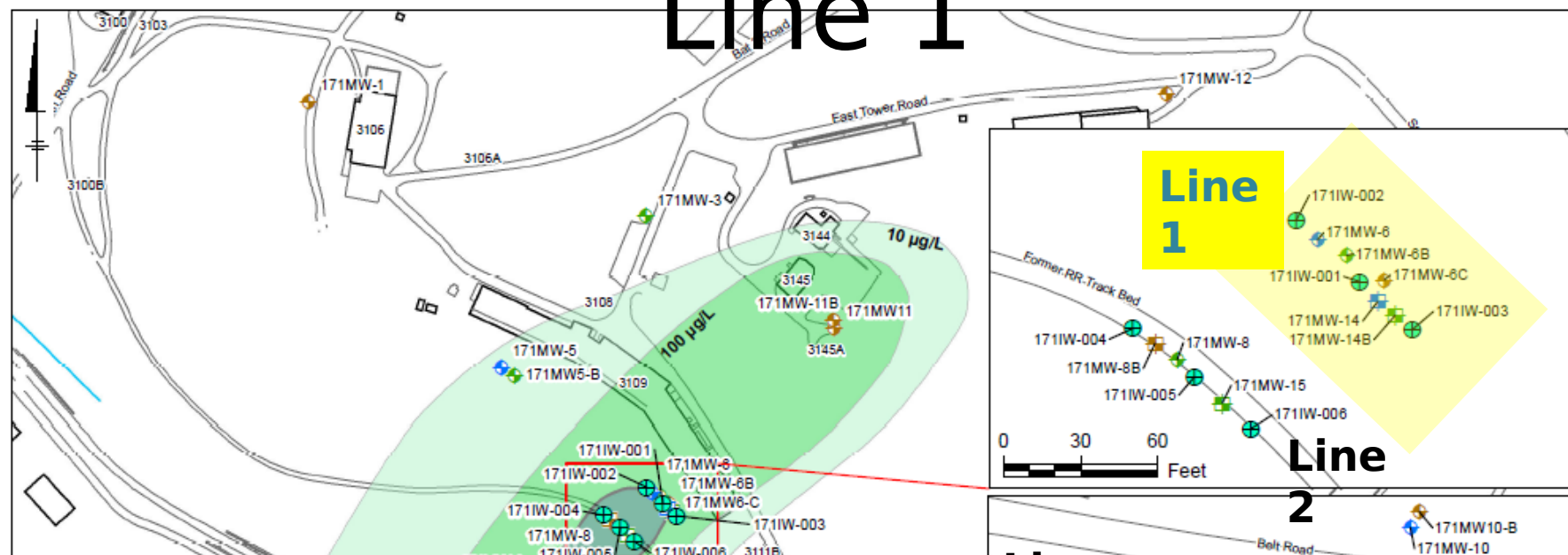




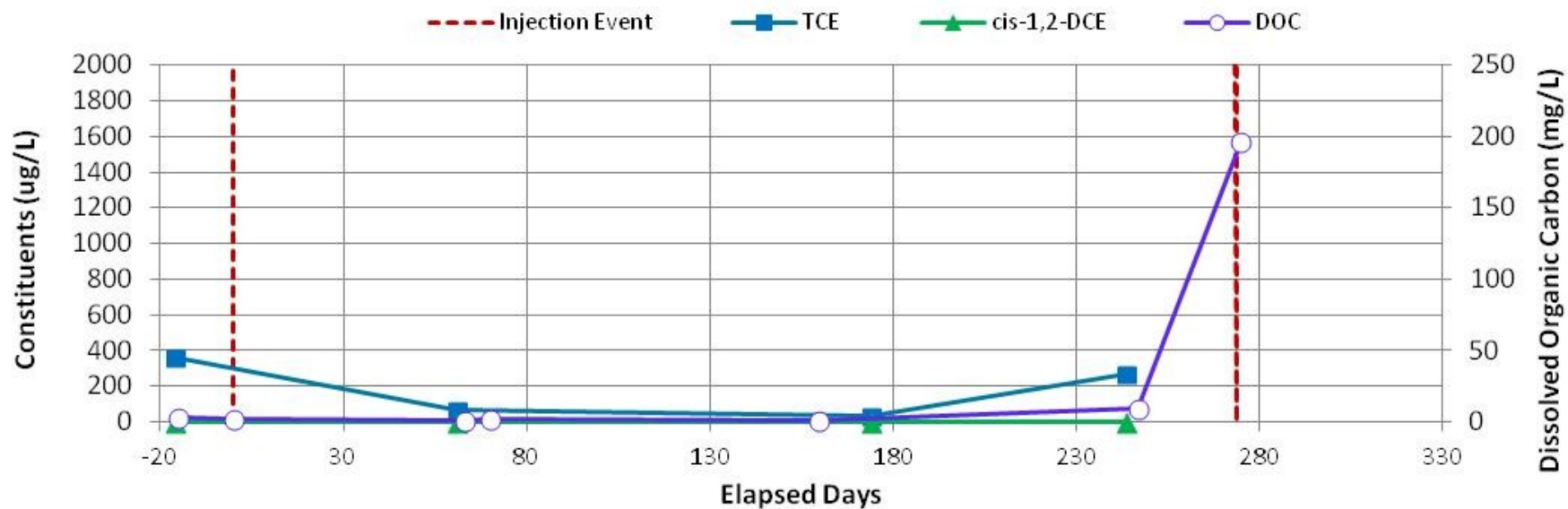
# In-Situ Bioremediation



# In-Situ Bioremediation - Line 1

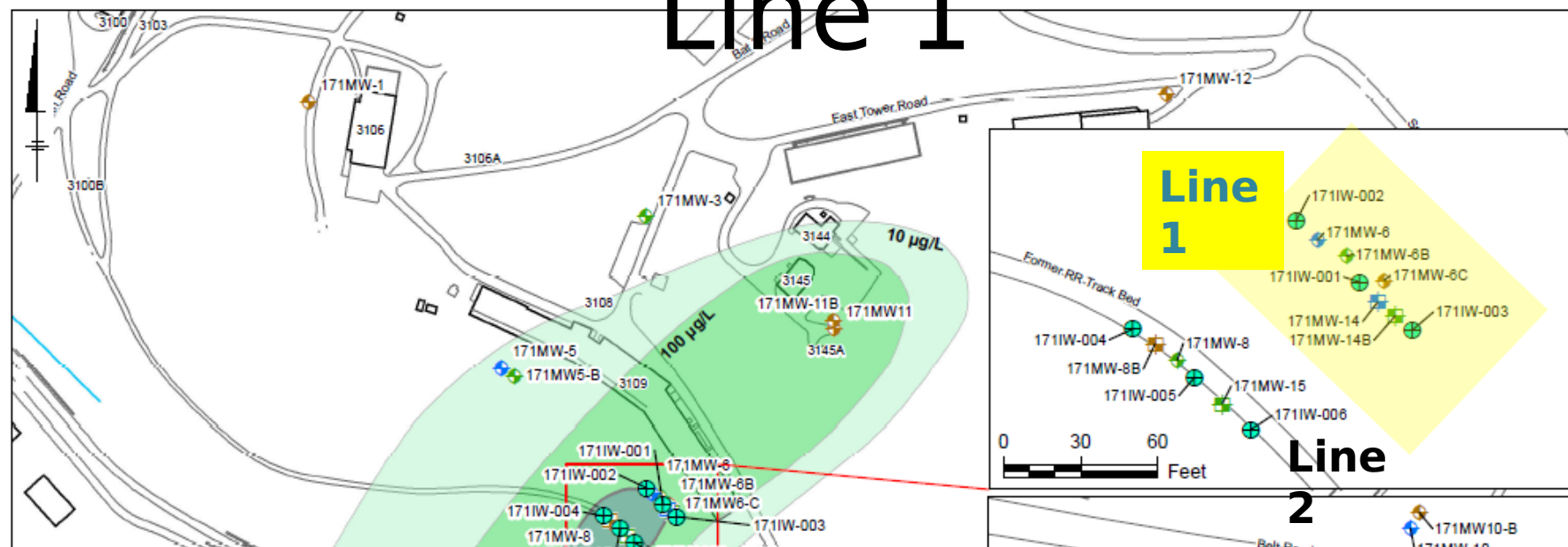


## 171MW-6

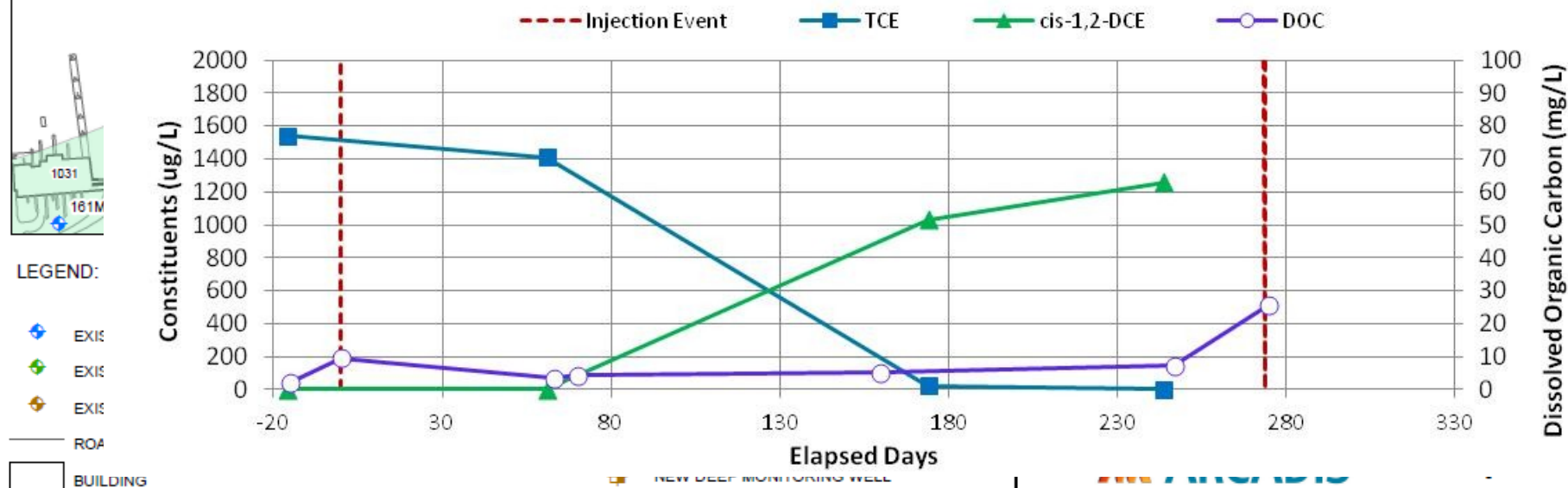




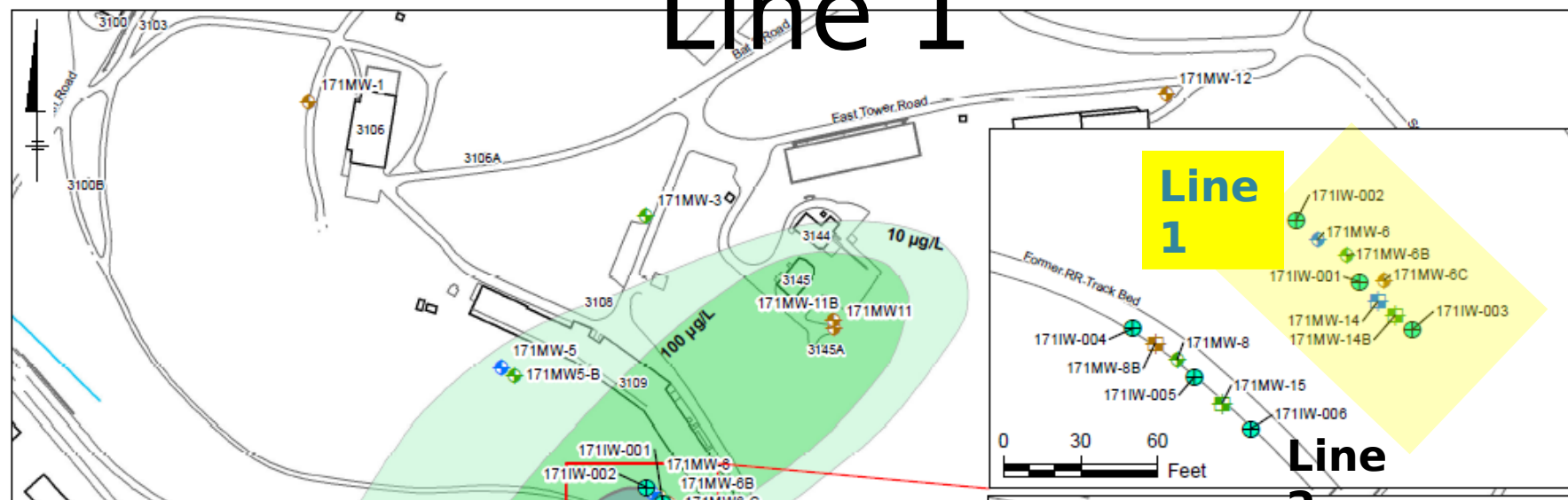
# In-Situ Bioremediation - Line 1



## 171MW-6B

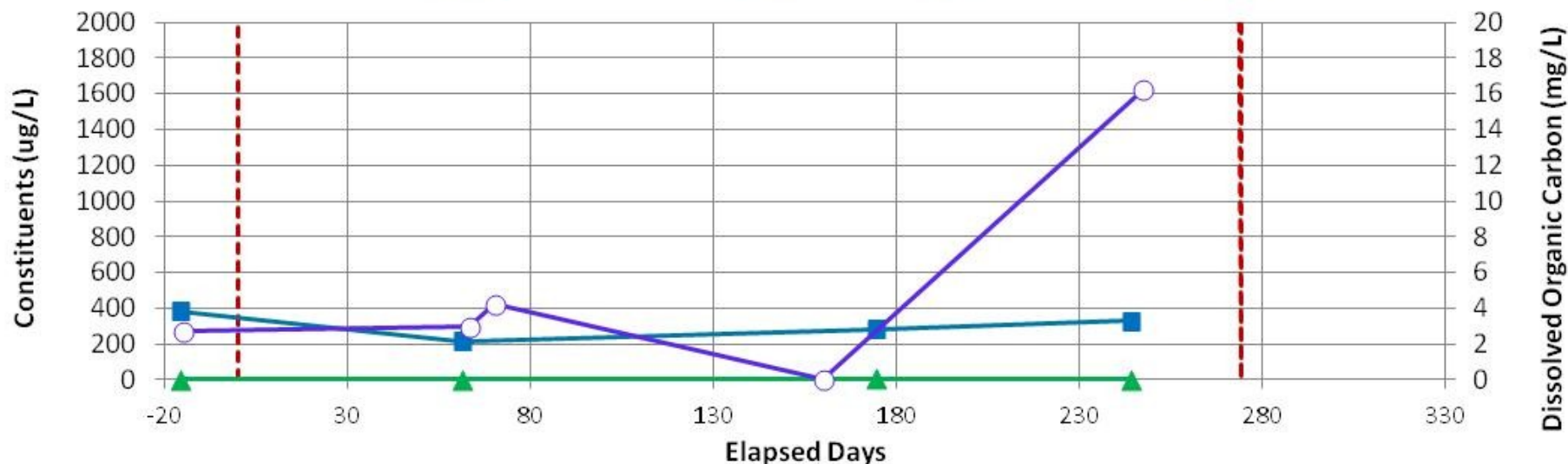


# In-Situ Bioremediation - Line 1



171MW-6C

--- Injection Event    ■ TCE    ▲ cis-1,2-DCE    ○ DOC



BUILDING

NEW DEEP MONITORING WELL

INJECTION EVENT

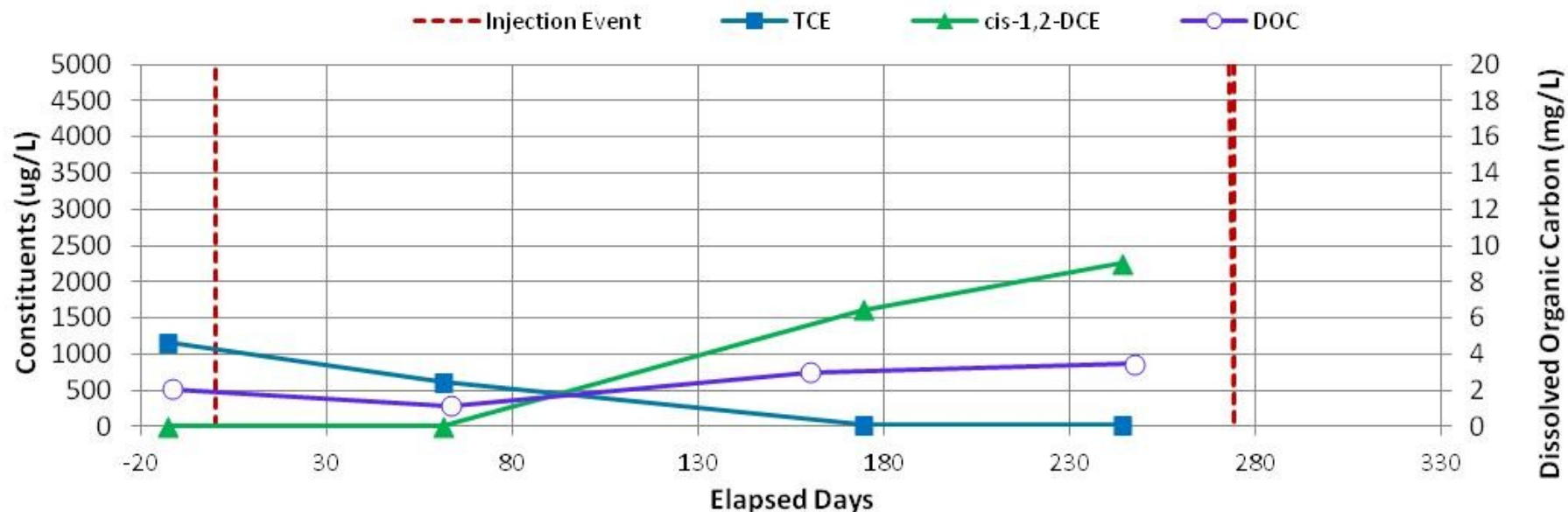


# Line 1












Line  
2

**171MW-14B**



--- Injection Event      —■— TCE      —▲— cis-1,2-DCE      —○— DOC



|   |   |   |                                  |
|---|---|---|----------------------------------|
|  | EXISTING SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS          |  | NEW SHALLOW INJECTION WELL       |
|  | EXISTING INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS |  | NEW DEEP INJECTION WELL          |
|  | EXISTING DEEP BEDROCK WELL, > 100 FT DEPTH BGS            |  | NEW SHALLOW MONITORING WELL      |
|  | ROAD  |  | NEW INTERMEDIATE MONITORING WELL |
|  | BUILDING  |  | NEW DEEP MONITORING WELL         |

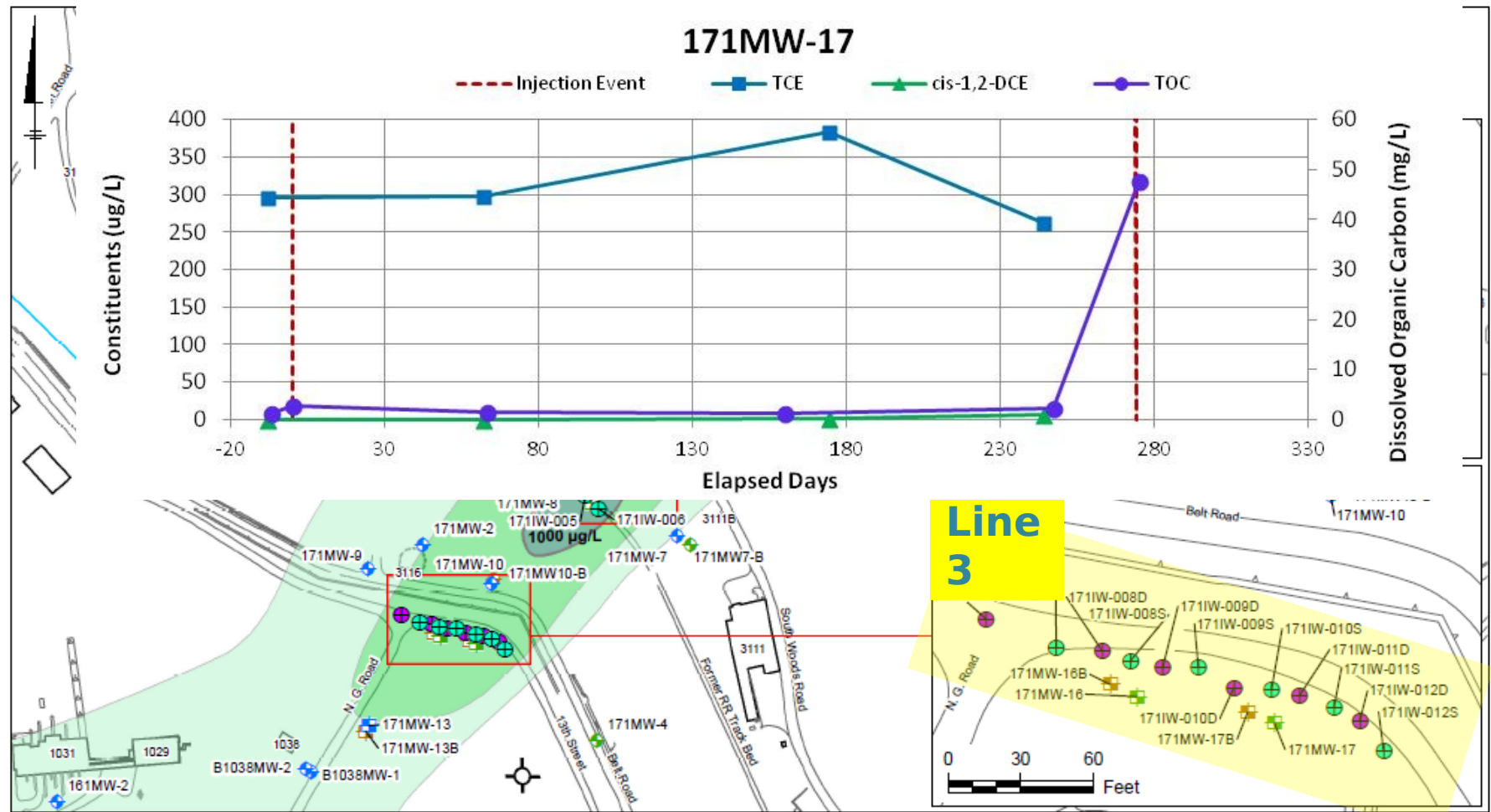
NEW SHALLOW INJECTION WELL  
NEW DEEP INJECTION WELL  
NEW SHALLOW MONITORING WELL  
NEW INTERMEDIATE MONITORING WELL  
NEW DEEP MONITORING WELL

### LAYOUT OF FOCUSED ENHANCED REDUCTIVE DECHLORINATION (ERD) WELL NETWORK

FIGURE  
4

# In-Situ Bioremediation -

## Line 3



### LEGEND:

- ◆ EXISTING SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS
- ◆ EXISTING INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- ◆ EXISTING DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ◆ NEW SHALLOW MONITORING WELL
- ◆ NEW INTERMEDIATE MONITORING WELL
- ◆ NEW DEEP MONITORING WELL
- ⊕ NEW SHALLOW INJECTION WELL
- ⊕ NEW DEEP INJECTION WELL
- ⊕ NEW SHALLOW MONITORING WELL
- ⊕ NEW INTERMEDIATE MONITORING WELL
- ⊕ NEW DEEP MONITORING WELL

MID-VALLEY GROUNDWATER (PICA-204)  
PICATINNY ARSENAL, NEW JERSEY

**LAYOUT OF FOCUSED  
ENHANCED REDUCTIVE DECHLORINATION (ERD)  
WELL NETWORK**

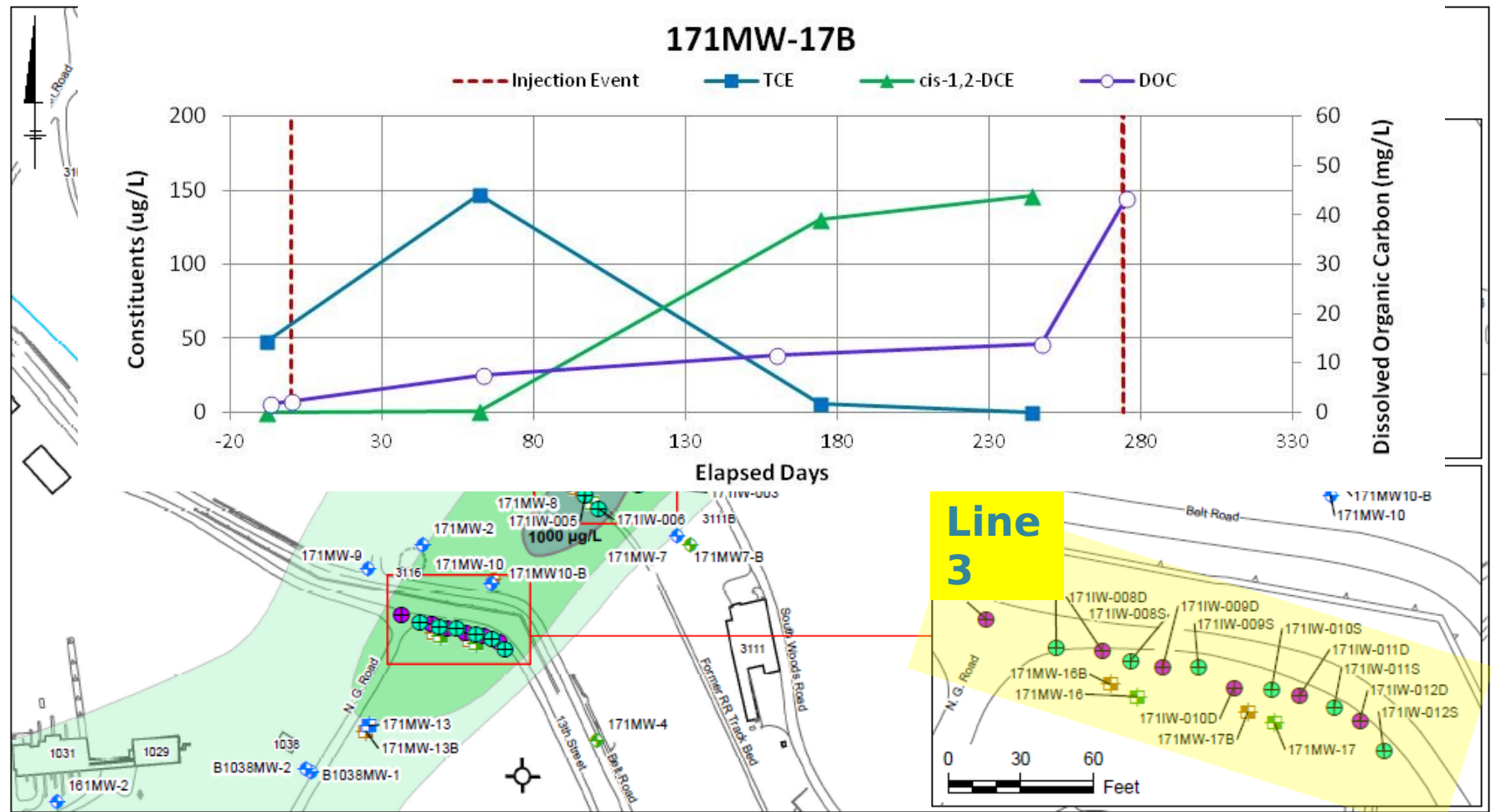


FIGURE  
**4**



# In-Situ Bioremediation -

## Line 3



### LEGEND:

- EXISTING SHALLOW BEDROCK WELL, < 65 FT DEPTH BGS
- EXISTING INTERMEDIATE BEDROCK WELL, 65 - 100 FT DEPTH BGS
- EXISTING DEEP BEDROCK WELL, > 100 FT DEPTH BGS
- ROAD
- BUILDING
- NEW SHALLOW INJECTION WELL
- NEW DEEP INJECTION WELL
- NEW SHALLOW MONITORING WELL
- NEW INTERMEDIATE MONITORING WELL
- NEW DEEP MONITORING WELL

0 230 460 Feet

GRAPHIC SCALE

MID-VALLEY GROUNDWATER (PICA-204)  
PICATINNY ARSENAL, NEW JERSEY

LAYOUT OF FOCUSED  
ENHANCED REDUCTIVE DECHLORINATION (ERD)  
WELL NETWORK

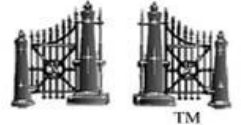


FIGURE  
4



# In-Situ Bioremediation Summary

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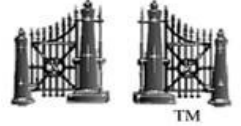
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- Early results look favorable
  - Reducing conditions are becoming established.
- TCE decreasing and degrading to cis-1,2-DCE
- First quarter 2014 sampling is underway. First sampling event since second injection





US Army Garrison

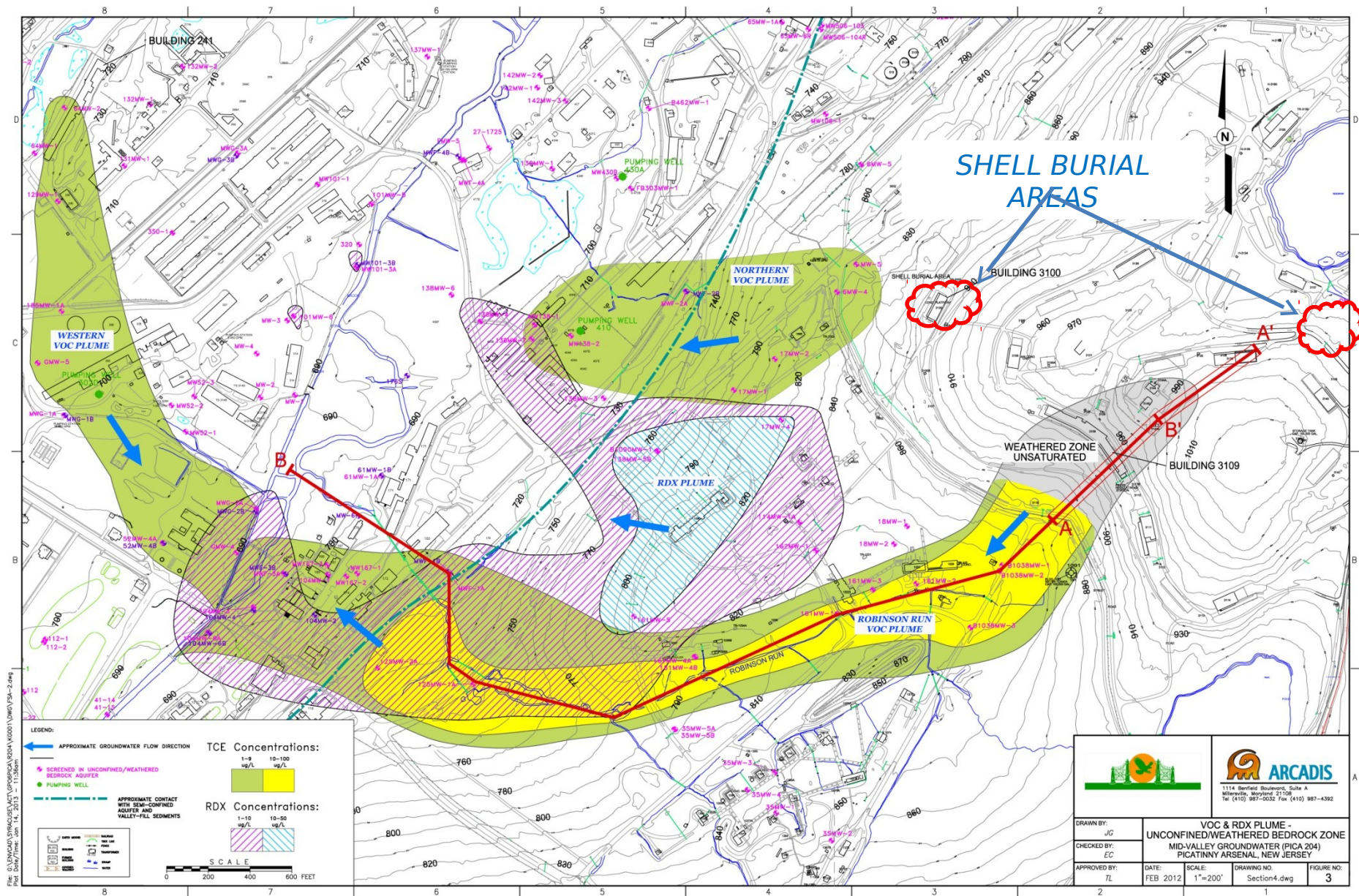


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# PICA 204 Mid Valley

Shell burial Area







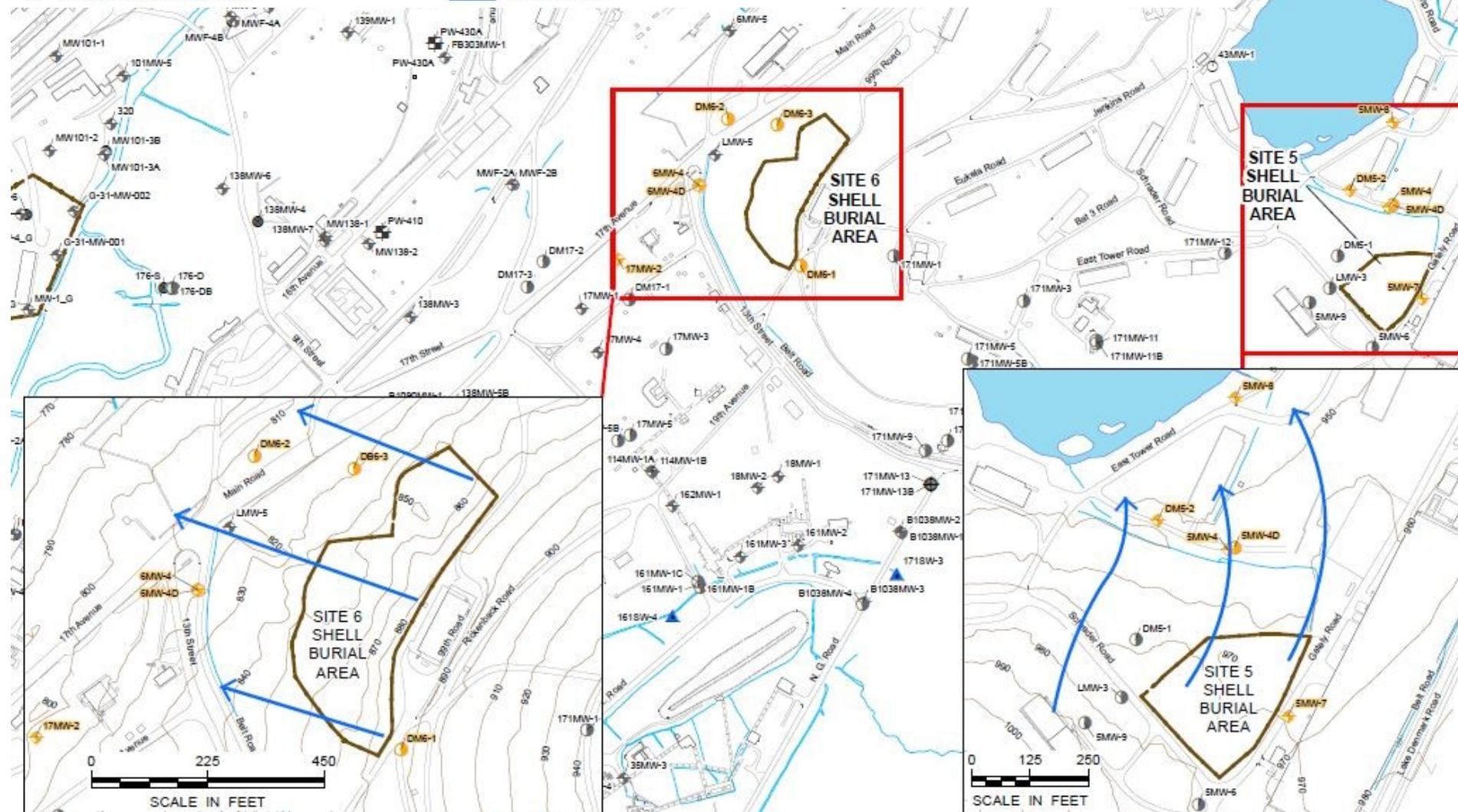
-  SUPPLY WELL
-  UNKNOWN WELL CONSTRUCTION
-  BEDROCK
-  PROPOSED BEDROCK WELL
-  UNCONFINED AND/OR WEATHERED BEDROCK UNIT WELL
-  UPPER SEMI-CONFINED WELL
-  LOWER SEMI-CONFINED WELL
-  SURFACE WATER SAMPLE
-  AREA
-  ROAD
-  10 FT CONTOUR
-  BUILDING
-  WATER FEATURE

 WELL ID SHELL BURIAL AREAS LTM

 GENERALIZED GROUNDWATER FLOW DIRECTION

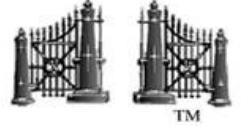
ACRONYM:

LTM - LONG TERM MONITORING





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# PICA 204 Mid Valley

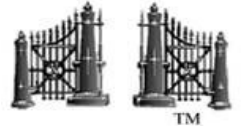
RDX Plume, Northern VOC  
Plume, Western VOC Plume





# PICA 204 Mid Valley

- RDX Plume:
  - Four quarters of data
  - Stable to declining trends of RDX
- Northern Plume - Generally low level (e.g., 1.0 ug/L to 5.0 ug/L) and stable or declining TCE trends
- Western plume
  - GMW-5: slight increase in TCE (i.e., 2.14 ug/L to 4.6 ug/L) over four quarters
  - Remaining wells have stable and low level TCE (e.g. less than 6 ug/L)
- Conclusion: only one year of LTM sampling conducted to date; continue per the prescribed LTM regimen



# Next Steps

- Good results from second EVO injection – monitor carbon concentrations and distribution
- Continue performance sampling and MNA sampling for TCE and RDX in groundwater



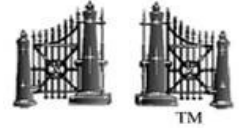


# RAB UPDATE

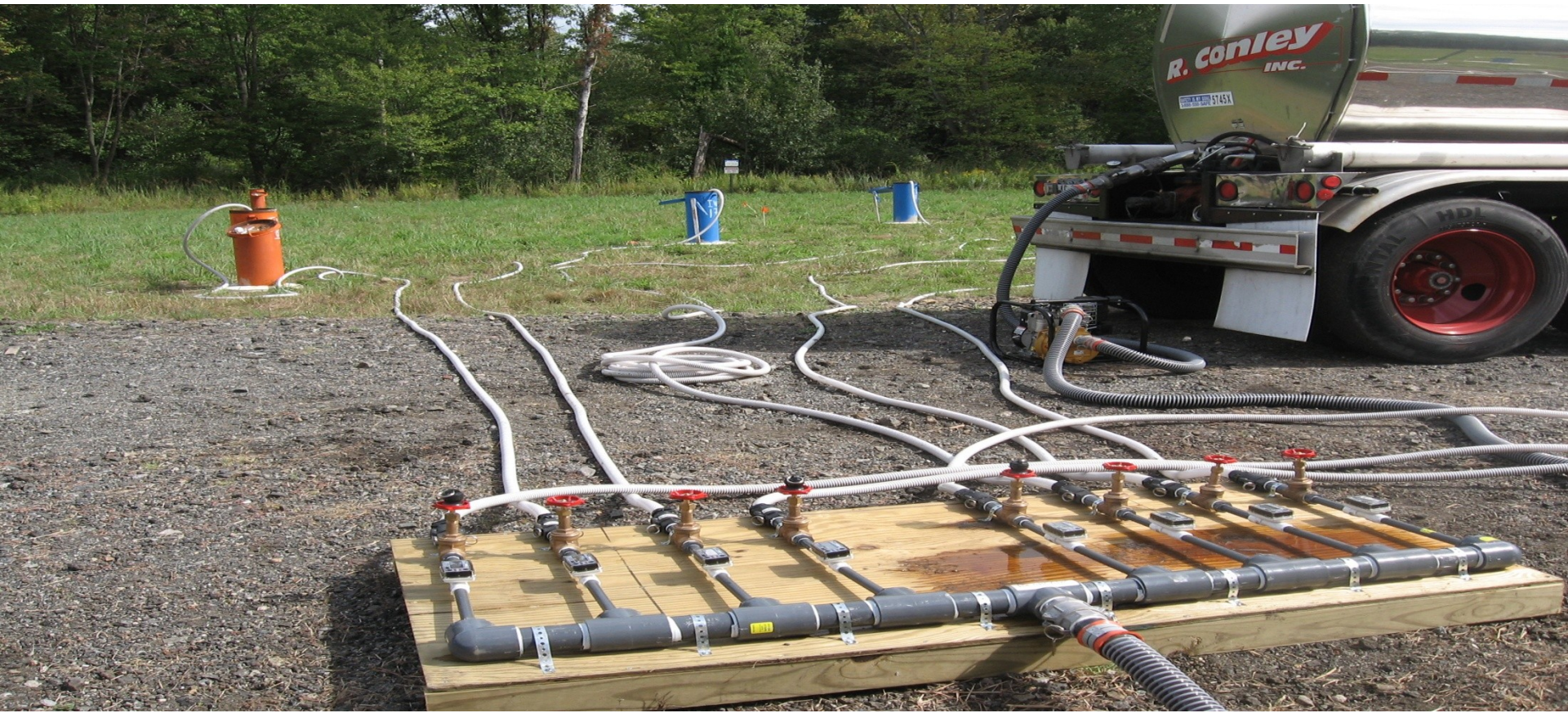
## Area B Groundwater

February 6, 2014

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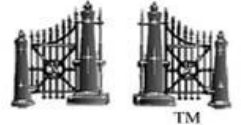
Picatinny Arsenal





# PICA 205 (Area B Groundwater)

US Army Garrison



Picatinny Arsenal

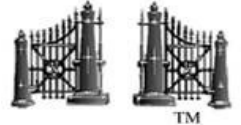
- ROD signed; In-situ bioremediation and LUCs implemented in 2009
- 2009 – 2014: ARCADIS performs GW remedy operation, maintenance, and monitoring; and annual inspection; prepares Annual Groundwater and Certification Reports; and biennial CEA Report
- 2015 and Beyond: Inspection, operation, monitoring (VOCs), and certification required annually





# PICA 205 (Area B Groundwater)

US Army Garrison



Picatinny Arsenal

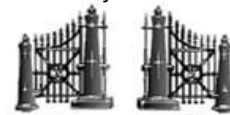
- Contaminant History: TCE plume
- Remedy: Enhanced biodegradation via molasses injection
- ROD stipulates attainment of SCLs within 7 years
- Sixth year post remedy implementation
- 6 injections conducted – last injection 06/2011
- SCLs attained for 7 of 9 wells
  - VC in two monitoring wells (MW-8 and MW-16)
  - Concentrations are 2.69 ppb and 35.2 ppb; respectively
  - VC is expected to decline both anaerobically or aerobically
- Conclusion: Remedy is functioning as anticipated. Should achieve goals within 7 years. Annual sampling, perhaps operation, and reporting expected in 2015 and beyond





# PICA 205 (Area B Groundwater) COC Concentrations as of 2013

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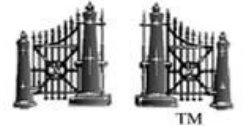
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| COC     | SCL<br>(ug/L) | MW-17<br>(ug/L) | MW-16<br>(ug/L) | MW-15<br>(ug/L) | IW-3<br>(ug/L) | MW-6<br>(ug/L) | MW-6B<br>(ug/L) | MW-8<br>(ug/L) |
|---------|---------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|----------------|
| PCE     | 1.0           | ND              | ND              | ND              | ND             | ND             | ND              | ND             |
| TCE     | 1.0           | ND              | 0.298           | ND              | ND             | ND             | ND              | ND             |
| cDCE    | 70            | ND              | 7.37            | ND              | 0.394          | ND             | 0.673           | 1.45           |
| 1,1-DCE | 1             | ND              | ND              | ND              | ND             | ND             | ND              | ND             |
| VC      | 1.0           | ND              | 35.2            | ND              | ND             | 0.544          | ND              | 2.69           |

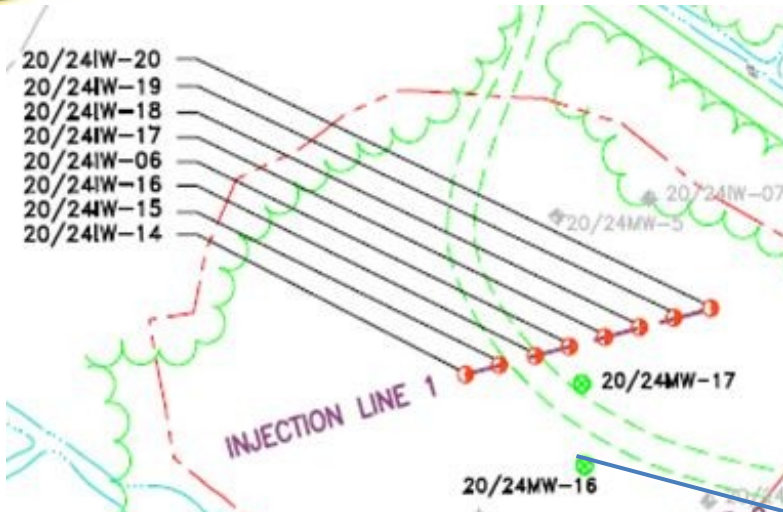


# PICA 205 (Area B Groundwater) Trend Plots for MW-16 and MW-8

US Army Garrison



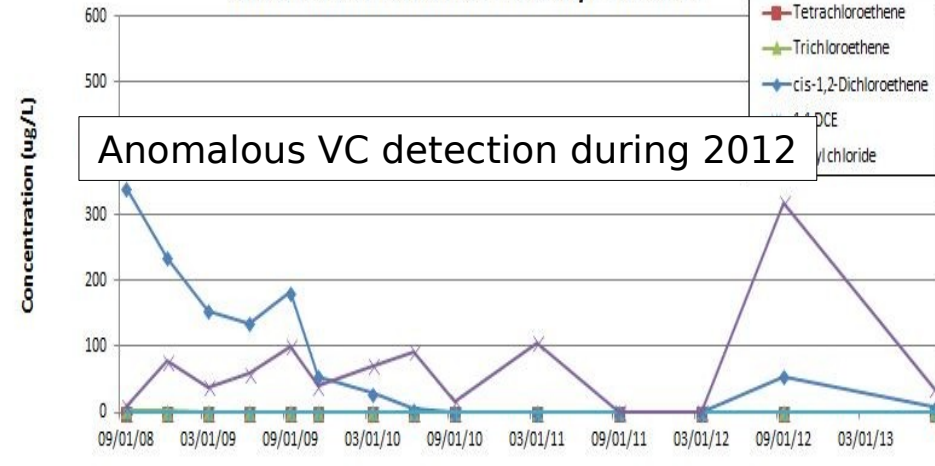
Picatinny Arsenal



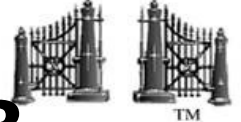
## LEGEND:

- EXISTING MONITORING WELL
- EXISTING INJECTION WELL
- PERFORMANCE MONITORING WELL
- SURFACE WATER SAMPLE
- HISTORICAL SURFACE WATER SAMPLE

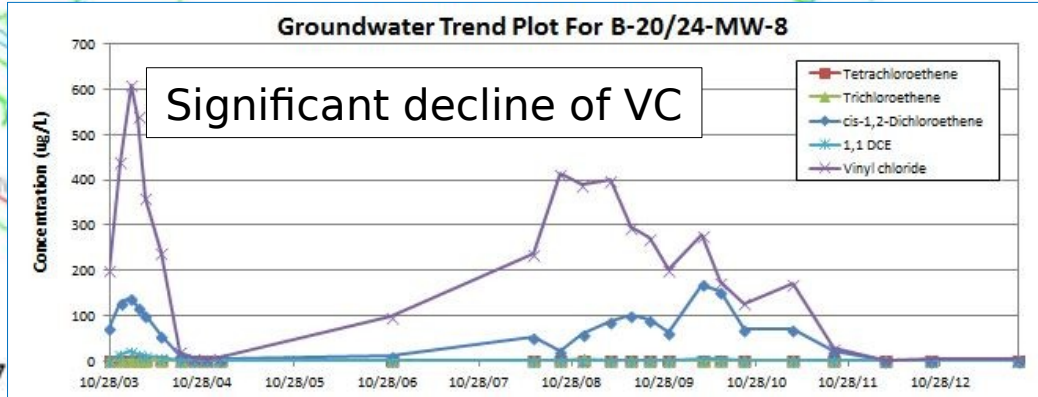
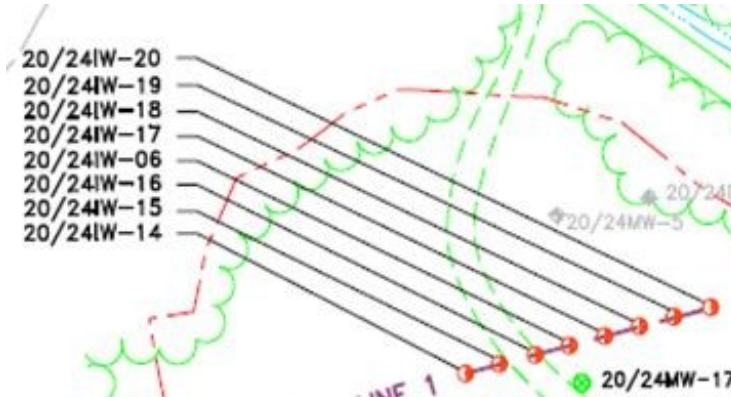
Groundwater Trend Plot For B-20/24-MW-16



LANDFILL POND



# PICA 205 (Area B Groundwater) Trend Plots for MW-16 and MW-8



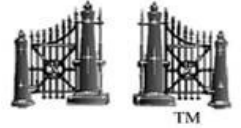
## LEGEND:

- EXISTING MONITORING WELL
- EXISTING INJECTION WELL
- PERFORMANCE MONITORING WELL
- SURFACE WATER SAMPLE
- HISTORICAL SURFACE WATER SAMPLE





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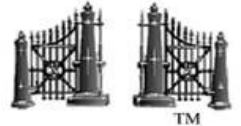
Picatinny Arsenal

# PICA 002 (Site 34 – Former Lower Burning Ground)



# PICA 002 (Site 34 Former Lower Burning Ground)

US Army Garrison



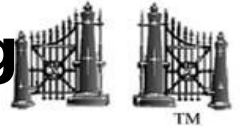
Picatinny Arsenal

- ROD signed 2005;
- Final RD and ESD planned by March 2014
- GW monitoring implemented in Q1 2014
- RIP by July 2014
- RAR by September 2014
- LUCs and Annual Certification by December 2014
- 2015 and Beyond: Annual Inspections (LUC, SW, and Wetland), Mowing, monitoring (metals) and reporting
  - 2015 - Quarterly GW monitoring /reporting
  - 2016 & 2017 - Semi Annual GW monitoring/reporting
  - 2018 and beyond - Annual GW monitoring/reporting



# **PICA 002 (Site 34 Former Lower Burning Ground) - TECHNICAL DISCUSSION**

US Army Garrison



Picatinny Arsenal

- RD and ESD RTC submitted 1/17/14
  - EPA approved 1/22/14
  - DEP approval outstanding
  - LURP Comments outstanding
- Quarterly GW monitoring starting Q1
- Phragmites cutting Feb 2014
- Brush clearing/Survey Control March 2014
- Earthwork/Wetland Enhancement March 2014 – July 2014
- RAR – Sept 2014



Thank You